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(54) Cleaning metal surfaces

(57) A reflective metal surface, e.g. an electrical contact surface, is cleaned by exposing the surface to pulsed laser radiation. The progress of the evaporation can be monitored by examination of the emission spectrum of the transient plasma produced by each laser pulse. An apparatus for carrying out the process is also described.

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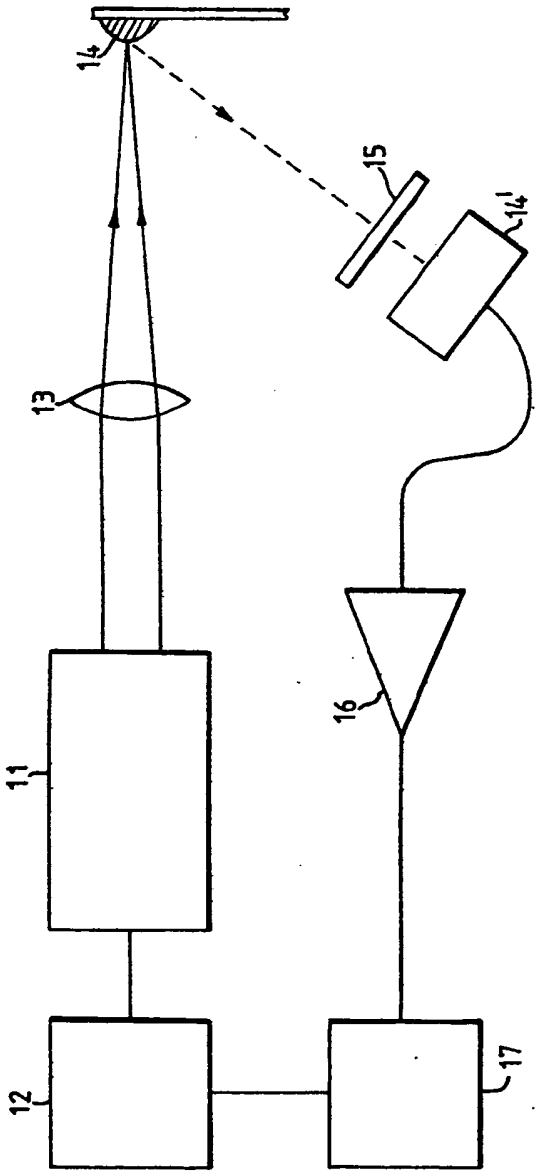

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SPECIFICATION

Cleaning metal surfaces

This invention relates to electrical contacts, and in particular to a method and apparatus for removing contaminant deposits from such contacts.

Electrical contacts, e.g. for use in switches or relays, are frequently contaminated with organic and inorganic materials during manufacture. The presence of this contamination on the contact surface can result in carbonisation and/or tarnishing during subsequent use. This in turn can lead to a number of contact faults, particularly on unacceptably high contact resistance. Various methods have been proposed for cleaning contacts prior to use in high reliability applications. Typically the contacts are treated with a solvent which removes soluble organic residues. However such treatment is not fully effective as polymeric and/or inorganic materials may still adhere to the contact surface.

The object of the present invention is to minimise or to overcome this disadvantage.

According to one aspect of the invention there is provided a method of cleaning a reflective metal surface, the method including exposing the surface to pulsed coherent radiation of sufficient intensity to vapourise contaminant materials adherent to the metal surface.

According to another aspect of the invention there is provided an apparatus for removing contaminant materials from a reflective metal surface, the apparatus including a pulsed laser, means for focussing the laser output on to the metal surface, spectroscopic means for detecting non-metallic elements in the material evaporated from the metal surface by the laser beam, and feedback means for disabling the laser when said non metallic elements are absent from the evaporated material.

An embodiment of the invention will now be described with reference to the accompanying drawing in which the single figure is a schematic diagram of a contact cleaning apparatus.

Referring to the drawing, the contact cleaning apparatus includes an ultraviolet laser 11 of the pulsed type driven by a power supply 12 and provided with a converging optical system 13, e.g. a lens, whereby the laser output may be focussed on to the surface of a contact 14. Typically we employ a krypton fluoride gas laser having a wavelength of 249 nm for this purpose, but it will be apparent that the technique is not limited to this particular laser system. The constraints on the laser are that it should provide a sufficient energy density to effect vaporisation and that it should have a wavelength at which the contaminant materials are absorbent. We have found that a surface energy density of 0.1 J/cm^2 to 0.8 J/cm^2 is sufficient to provide vaporisation of surface deposits. As the metal surface is reflective there is substantially no depletion of the contact material.

Advantageously the evaporation process may be monitored to establish the point at which removal of contaminant material is complete. After each laser pulse a transient incandescent plasma is produced at the evaporation site. The emission spectrum of this plasma is of course characteristic of those elements present. Light from the plasma is received by a photodetector 14 via a filter 15 whose passband corresponds to the emission lines of the non-metallic contaminant elements, e.g. carbon and/or sulphur. The photodetector output is coupled via amplifier 16 to a control circuit 17 which circuit disables the laser when the characteristic emission lines are no longer present, i.e. when all the contaminant material has been depleted. The contact 14 is then removed for further processing.

Although the technique has been described in relation to electrical contacts it will be appreciated that it is not so limited and that it can be applied to other reflective metal surfaces. In particular the technique can be used with advantage for the treatment of connector contacts and PCB edge contacts.

CLAIMS

1. A method of cleaning a reflective metal surface, the method including exposing the surface to pulsed coherent radiation of sufficient intensity to vapourise contaminant materials adherent to the metal surface.

2. A method as claimed in claim 1 wherein said radiation is provided by an ultraviolet laser.

3. A method as claimed in claim 2, wherein said laser is a krypton fluoride laser.

4. A method of cleaning a reflective metal surface substantially as described herein with reference to the accompanying drawings.

5. A method as claimed in claim 1, 2 or 3, wherein the laser provides a surface energy density of 0.1 to 0.8 J/cm^2.

6. An appparatus for removing contaminant materials from a reflective metal surface, the apparatus including a pulsed laser, means for focussing the laser output on to the metal surface, spectroscopic means for detecting non-metallic elements in the material evaporated from the metal surface by the laser beam, and feedback means for disabling the laser when said non metallic elements are absent from the evaporated material.

7. An apparatus as claimed in claim 6, wherein said laser is an ultraviolet laser.

8. An apparatus as claimed in claim 7, wherein said laser is a krypton fluoride laser.

9. An apparatus for cleaning a reflective metal surface substantially as described herein with reference to the accompanying drawings.

10. An electrical contact treated by a method as claimed in any one of claims 1 to 5.

11. A printed circuit board treated by a method as claimed in any one of claims 1 to 5.

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